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1987–1989

ANNUAL SURVEY REPORT

U.S. Pharmaceutical Industry

Pharmaceutical Manufacturers Association

ANNUAL SURVEY REPORT

PMA 1987-1989

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Foreword

The Pharmaceutical Manufacturers Association (PMA) is a non-profit trade association of over 100 research-based pharmaceutical companies. These firms produce most of the ethical pharmaceuticals sold in the United States and a substantial portion of the world supply.

The Annual Survey is designed to provide information on the ethical pharmaceutical industry to business executives, financial analysts, educators, and other interested groups.

Survey questions are updated periodically and the scope of the survey expanded or reduced to reflect changing priorities. However, an effort is made to maintain continuity and comparisons with earlier surveys can be made in most categories.

Responses to surveys are reasonably uniform and consistent, but there are minor variations, from year to year. To compensate for these, adjustments are made based on supplementary data available to PMA from other sources. No adjustment has been made for inflation; data are presented in current dollars for manufacturers' sales and R&D expenditures.

Although this is a membership survey, selected operational totals include estimates for nonmember firms based on data obtained from other sources. For example, aggregate human-dosage form drug sales have been extrapolated to represent the entire industry. However, extrapolation was not possible for bulk sales, veterinary use pharmaceuticals, foreign data or R&D. In order to maintain continuity of the data, some firms who are no longer PMA member firms are represented by estimate in the data for PMA members.

TRENDS

1987-1989[a] Pharmaceutical Industry Operations
PMA Member Firms

Global sales in 1988 were estimated to exceed $46 billion, nearly three times higher than sales ten years ago. Global R&D expenditures exceeded $6 billion for the first time and have more than quadrupled since 1978. The trends for 1987-1989 are shown below.

- Global Sales, Ethical Pharmaceuticals, Human and Veterinary Use:
  1987 $41.6 billion, up 12.1% from 1986
  1988 $46.2 billion, up 11.0% from 1987
  1989 $51.5 billion, up 11.5% from 1988

- U.S. Sales,[b] Human-Use, Dosage-Form Pharmaceuticals:
  1987 $28.3 billion, up 14.5% from 1986
  1988 $31.8 billion, up 14.0% from 1987
  1989 $35.9 billion, up 12.3% from 1988

- Global R&D Expenditures for Human and Veterinary Use Pharmaceuticals:
  1987 $5.5 billion, up 17.0% from 1986
  1988 $6.5 billion, up 18.2% from 1987
  1989 $7.3 billion, up 12.3% from 1988

Table 1

[a]Figures for 1988–89 are budgeted or estimated figures.
[b]U.S. sales figures apply to all U.S. firms, not PMA member firms only.

U.S. Pharmaceutical Industry Sales & R&D Expenditures, 1963-1989[a] (millions of dollars) 1

Year	U.S. Sales[b]	Global Sales and R&D-PMA Member Firms		
		Sales		R&D[d]
		Human and Veterinary[c]		
	Human Dosage	*Dosage Only*	*Dosage & Bulk*	*Human & Veterinary*
1989[e]	**35,929**	49,607	51,492	7,271
1988[e]	**31,796**	44,506	46,197	6,461
1987	**28,288**	40,111	41,635	5,505
1986	**25,227**	35,685	37,137	4,740
1985	**22,065**	30,698	32,026	4,078
1984	**19,345**	28,615	29,854	3,579
1983	**17,278**	26,254	27,506	3,218
1982	**15,394**	24,466	25,654	2,774
1981	**13,000**	22,378	23,530	2,340
1980	**11,799**	21,460	22,513	1,977[f]
1979	**10,044**	17,789	18,939	1,627
1978	**9,156**	15,463	16,431	1,404
1977	**8,233**	13,377	14,155	1,276
1976	**7,669**	12,295	13,035	1,164
1975	**6,895**	11,129	11,769	1,062
1974	**6,083**	9,755	10,361	942
1973	**5,507**	8,403	8,839	825
1972	**5,018**	7,576	7,930	726
1971	**4,667**	6,787	7,605	684
1970	**4,322**	6,226	6,637	619
1969	**4,008**	5,632	6,008	550
1968	**3,655**	5,097	5,482	495
1967	**3,226**	4,546	4,941	461
1966	**3,011**	4,105	4,509	416
1965	**2,779**	3,758	4,136	365
1964	**2,479**	3,331	3,643	310
1963	**2,317**	3,082	3,399	292

[a]Additional data are available to 1954. See earlier Annual Survey Reports.

[b]U.S. Sales of finished prescription and "OTC ethical" dosage forms.

[c]Global sales are defined to include total ethical pharmaceutical sales within the United States, exports to nonaffiliated firms and sales abroad of U.S. affiliates. Figures apply to PMA member companies only. Historical series has been adjusted accordingly.

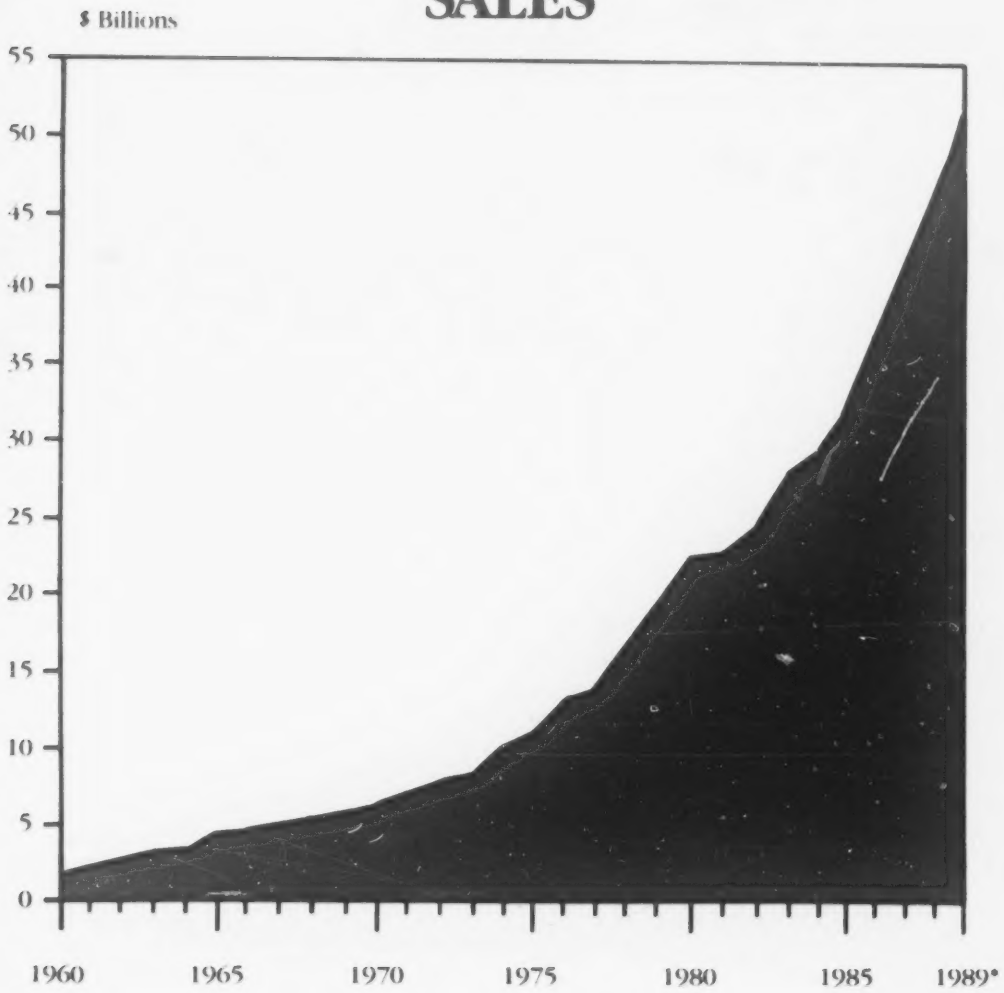
[d]Global R&D includes all ethical pharmaceutical research and development financed or conducted by U.S. pharmaceutical companies in the U.S. and abroad, and in the U.S. only by U.S. based subsidiaries of foreign-owned firms.

[e]PMA estimates based on member company budgeted figures or estimates.

[f]R&D figures for 1979 and 1980 reflect a 21% increase in expenditures; however, part of this increase is due to improved reporting of expenditures in foreign countries. Adjusting for this improved reporting results in an 18% increase.

Source: PMA Annual Survey Report

SALES



*Projected

SALES[a]

Highlights

U.S. sales increased 10.2% in 1987 and 12.5% in 1988—sales are predicted to increase 13.1% in 1989. Foreign sales increased by 15.6% in 1987. Sales of prescription legend products represent almost 90% of the ethical market in the U.S. European countries receive over 48% of sales abroad; the Pacific and Far East nations represent about one fourth of sales in 1987. The leading selling product class in the U.S. is central nervous system products; anti-infectives are the leading sellers abroad. In the U.S. market, more than two-thirds of manufacturers' sales are distributed through wholesalers.

1986-1989 Sales in the United States and Abroad

- U.S. sales volume rose 10.2% in 1987, an estimated 12.5% in 1988, and was projected to increase by 13.1% in 1989; foreign sales volume increased by 15.6% in 1987, an estimated 8.2% in 1988, and a projected 8.4% in 1989.
- U.S. sales accounted for 64% of volume for U.S. manufacturers in 1987, 65% in 1988 and 66% in 1989.
- Exports amounted to $2,015 million in 1987, down 1.4% from 1986.

Tables 2 and 3.

Ethical Pharmaceuticals Sales Growth, (millions of dollars) **2**

Year	Domestic Sales	Percent Change	Foreign Sales	Percent Change	Total	Percent Change
1986	$24,106.8	+14.0%	$13,030.5	+19.9%	$37,137.3	+16.0%
1987	$26,566.1	+10.2%	$15,068.4	+15.6%	$41,634.5	+12.1%
1988	$29,893.1	+12.5%	$16,303.8	+8.2%	$46,196.9	+11.0%
1989	$33,815.2	+13.1%	$17,677.0	+8.4%	$51,492.2	+11.5%

[a]Sales for PMA member firms only.

Ethical Pharmaceutical Sales[a] of PMA Member Firms, Domestic and Foreign: Shares of End-Use Totals, 1987 (millions of dollars)

3

	Domestic U.S. Sales			Foreign Sales				
	To Private Sector	To Governments	Total Domestic Sales	Exports to Other Firms	Sales Abroad[b]	Total Foreign Sales	Total	Sales for Export Intra-Firm Transactions[c]
Dosage Form Human Use	$23,851.9 (61.2%)	$1,477.1 (3.8%)	$25,329.0 (65.0%)	$ 571.0 (1.5%)	$13,039.9 (33.5%)	$13,610.9 (35.0%)	$ 38,939.9 (100.0%)	$ 707.3
Dosage Form Veterinary Use	696.4 (59.5%)	4.2 (.3%)	700.6 (59.8%)	29.3 (2.5%)	441.0 (37.7%)	470.3 (40.2%)	1,170.9 (100.0%)	51.4
Bulk Human Use	199.3 (24.4%)	.6 (.1%)	199.9 (24.5%)	164.7 (20.2%)	450.1 (55.3%)	614.8 (75.5%)	814.7 (100.0%)	408.2
Bulk Veterinary Use	336.6 (47.5%)		336.6 (47.5%)	22.2 (3.1%)	350.2 (49.4%)	372.4 (52.5%)	709.0 (100.0%)	59.2
TOTAL	**$25,084.2**	**$1,481.9**	**$26,566.1**	**$ 787.2**	**$14,281.2**	**$15,068.4**	**$ 41,634.5 (100.0%)**	**$1,226.1**

[a]Sales are before deducting cash discounts and other marketing expenses, but after returns and allowances (domestic returns and allowances totalled $730 million).

[b]Export sales are f.o.b. U.S. port. Domestic sales figures are f.o.b. plant or warehouse. In addition, transportation costs for domestic sales were $184 million and net value of discounts on domestic sales $687 million.

[c]Sales for Export Intra-Firm Transactions are sales to own International Division or for export to subsidiary abroad and are included as part of cost in Sales Abroad. Addition of the two export columns will provide aggregate ethical pharmaceutical exports.

1987 Domestic Sales of Dosage Form Products

- Prescription drugs accounted for 90% of U.S. sales in the human use, dosage form category; over-the-counter ethical products accounted for 5% and the remainder came from sales of biologicals, diagnostics and other products.
- Government purchases of ethical pharmaceuticals constituted 6% of the total; 85% of these purchases were prescription drugs.

Domestic Sales of Dosage-Form, Human-Use Ethical Pharmaceuticals, 1987 (millions of dollars) 4

Dosage Form Human Use	To Private Sector	To Government	Total Domestic Sales
Prescription Legend[a]	$ 24,142.0	$ 1,399.4	**$ 25,541.4 (90.2%)**
Over-the-Counter Ethical[b]	1,431.2	46.4	**1,477.6 (5.2%)**
Biologicals[c]	696.1	160.6	**856.7 (3.0%)**
Diagnostic Products[d]	200.9	33.7	**234.6 (.8%)**
Other	168.0	9.5	**177.5 (.6%)**
Total, Dosage Form, Human Use	$26,638.2	$1,649.6	**$ 28,287.8 (100.0%)**

[a]Prescription Legend—A drug product which by federal law is available only by prescription from a licensed physician.

[b]Over-the-Counter Ethical—A drug product sold over the counter but primarily promoted to the professions. This does not include proprietary drugs (i.e., OTC products on display for purchase by customers).

[c]Biologicals—Bacterial and virus vaccine, antigens, antitoxins, toxoids, and analogous products (such as allergenic extracts) serums, plasmas, and other blood derivatives for human use.

[d]Dosage form, diagnostic agents for in-vivo use.

1987 Sales by Geographic Area

- Europe accounted for 49% of foreign sales; Japan, Australia and New Zealand 19%; Latin America 11%.

Distribution of Foreign Sales* by Geographic Area, 1986 and 1987

5

Area	Percentage of Total Foreign Sales	
	1986	1987
Canada	11.1%	10.8%
Latin America (Central America, South America, excluding Cuba)	12.4%	11.2%
Western Europe (excluding Turkey, Yugoslavia and Albania; including Greece and Scandinavia)	45.5%	48.9%
Middle East	2.3%	1.9%
Africa	3.4%	2.8%
Far East Pacific (from Pakistan to Pacific Islands)	5.3%	4.6%
Japan, Australia, New Zealand	19.3%	19.3%
Socialist Bloc (Eastern Europe, USSR, Yugoslavia, Albania, Cuba, Peoples' Republic of China, N. Korea, Laos, Cambodia and Vietnam)	.7%	.5%
Total	100.0%	100.0%

*Sales made abroad and exports to third parties.

1986 and 1987 Sales by Class of Customer

- Sales to wholesalers continued to increase.
- Total hospital sales declined from 12.7% to 11.9%.
- From 1977 to 1987 the wholesalers' percentage share of sales increased by more than 40 percent.

Tables 6 and 7

Manufacturers Sales of Human-Use, Dosage-Form Products, in the United States, 1986, 1987 (millions of dollars) 6

Class of Customer	Sales 1986	Market Share 1986	Sales 1987	Market Share 1987
Wholesalers	$17,238.8	68.3%	$19,463.7	68.8%
Retailers	3,907.3	15.5	4,499.3	15.9
Private Hospitals	2,003.4	8.0	2,089.8	7.4
State and Local Government Hospitals	581.2	2.3	598.5	2.1
Federal Hospitals	603.6	2.4	685.7	2.4
Other Federal Government	382.3	1.5	374.6	1.3
Practitioners	256.7	1.0	316.6	1.1
Manufacturers, Repackagers and Other Direct Sales	253.3	1.0	259.6	1.0
TOTAL	$25,226.6	100.0%	$28,287.8	100.0%

Ethical Pharmaceutical Manufacturers' Direct Human-Use Dosage-Form Sales in the United States by Class of Customer, 1977-1987 (odd years, percentage share of sales)

7

Class of Customer	1977	1979	1981	1983	1985	1987
Wholesalers	49.1%	53.0%	59.2%	61.7%	67.3%	68.8%
Retailers	25.5	22.5	18.0	17.2	16.0	15.9
Private Hospitals	15.1	14.9	13.9	12.6	8.8	7.4
State and Local Government Hospitals	4.5	4.0	3.9	3.5	2.5	2.1
Federal Hospitals	2.7	2.3	2.6	2.5	2.1	2.4
Other Federal Government	1.3	1.4	.9	1.2	1.6	1.3
Practitioners	1.1	1.2	.9	.7	.7	1.1
Manufacturers, Repackagers, and Other Direct Sales	.7	.7	.6	.6	1.0	1.0
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Domestic Sales by Product Class, Dosage-Form Ethical Drugs for Human Use, 1987 (millions of dollars)

8

Product Class	Prescription Drugs		Over-the-Counter Ethicals		Total	
	Sales	Market Share	Sales	Market Share	Sales	Market Share
Central Nervous System	$ 5,465.9	21.4%	$ 329.5	22.3%	$ 5,795.4	21.4%
Anti-Infectives	4,571.9	17.9	57.6	3.9	4,629.5	17.1
Gastrointestinal & Genitourinary	3,065.0	12.0	302.9	20.5	3,367.9	12.5
Neoplasms and Endocrine	3,524.7	13.8	26.6	1.8	3,551.3	13.1
Vitamins and Nutrients	715.2	2.8	260.1	17.6	975.3	3.6
Cardiovasculars	5,874.5	23.0	0	0	5,874.5	21.7
Respiratory System	1,430.3	5.6	286.7	19.4	1,717.0	6.4
Dermatologicals	383.1	1.5	203.9	13.8	587.0	2.2
Other	510.8	2.0	10.3	.7	521.1	2.0
TOTAL	$25,541.4	100.0%	$1,477.6	100.0%	$27,019.0	100.0%

1987 Sales by Product Class

- Products acting on the cardiovascular system became the largest product sales category, accounting for 22% of domestic dosage form sales in 1987.
- Other product classes, in order of U.S. sales rank in 1987, were central nervous system (21%), anti-infectives (17%), neoplasms and endocrine (13%), and gastrointestinal and genitourinary (12%).
- In foreign sales, anti-infectives are first, followed by cardiovasculars and central nervous system. These three groups accounted for over half of the sales abroad.

Tables 8 and 9

Foreign Sales by Product Class, Dosage-Form Ethical Drugs for Human-Use, 1987 (millions of dollars) 9

Product Class	1987	Percent
Anti-Infectives	$ 2,940.0	21.6%
Central Nervous System	2,218.6	16.3
Respiratory System	1,020.8	7.5
Gastrointestinal and Genitourinary	1,129.7	8.3
Neoplasms and Endocrine	1,796.6	13.2
Cardiovasculars	2,599.7	19.1
Vitamins and Nutrients	503.6	3.7
Dermatologicals	449.2	3.3
Biologicals	353.9	2.6
Diagnostic Agents	54.4	.4
Other Pharmaceutical Preparations	544.4	4.0
TOTAL	$13,610.9	100.0%

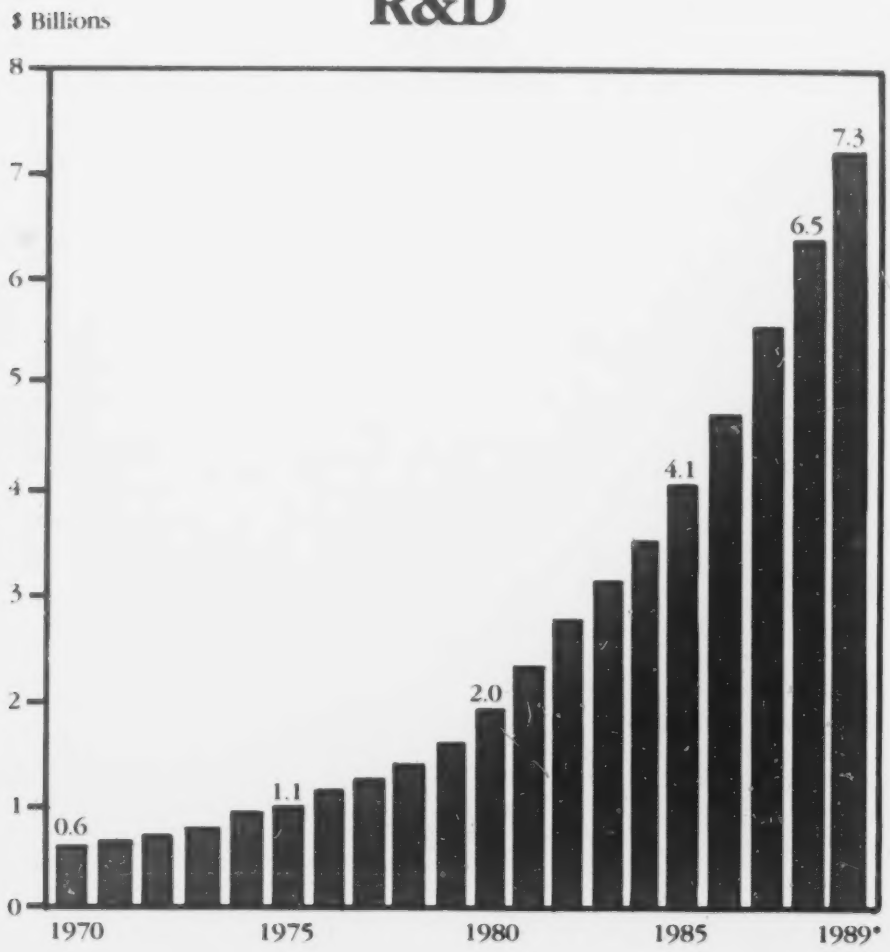
Industry Employment

- PMA member companies employed an estimated 317,820 persons worldwide in pharmaceutical operations in 1987.
- 45% were employed abroad.
- 36% of all U.S. employees were in production, 28% in marketing, and 23% in medical R&D.

Domestic & Foreign Employment, Ethical Pharmaceuticals, in 1985–1987 **10**

	1985	1986	1987
U.S. Employment	164,400	170,590	175,090
Production Workers	58,600	63,600	60,700
Marketing	44,600	46,300	47,920
Medical Research and Development	35,800	37,790	40,910
Administrative	18,100	16,800	19,000
Distribution & Others	7,300	6,100	6,560
Foreign Employment	148,300	148,500	142,730
TOTAL	**312,700**	**319,090**	**317,820**

R&D


$ Billions
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1970
1975
1980
1985
1989*
*Projected

R&D

Highlights

PMA members' continuing commitment to R&D is estimated at over $6.5 billion in 1988 and more than 80% of this spending is in the U.S. Manufacturers are devoting the largest percentage of R&D funds, both here and abroad, to research on cardiovascular products. R&D expenditures in the U.S. represent over 16% of total U.S. sales.

1986-1989 Research and Development

- Total R&D expenditures in 1987 reached $5.5 billion, up 17% from 1986. Expenditures for 1988 were budgeted at $6.5 billion.
- 97% of company R&D funds were spent on human-use pharmaceuticals, and 3% on animal-use products.
- Government contracts decreased from $4.1 million in 1986 to $3.9 million in 1987. $4.5 million was budgeted for 1988 and $6.2 million is projected for 1989.

Table 11

R&D Expenditures for Ethical Pharmaceuticals: 1986, 1987 (actual), 1988 (budgeted), and 1989 (projected) PMA Member Firms (millions of dollars)

11

	1986 Actual	1987 Actual	1988 Budgeted	1989 Projected
Company-Financed R&D Expenditures for Human Use Pharms.:				
Amount spent in United States	$3,720.9	$4,342.2	$5,046.6	$5,645.2
Within Firm	3,101.1	3,508.4	4,018.0	
Outside Firm	619.8	833.8	1,028.6	
Amount spent in foreign countries	$ 836.0	$ 968.1	$1,181.8	$1,371.1
Within Firm	700.7	783.1	946.4	
Outside Firm	135.3	185.0	235.4	
TOTAL Human-Use R&D	$4,556.9	$5,310.3	$6,228.4	$7,016.3
Company-Financed R&D Expenditures for Veterinary Use Pharms.:				
Amount spent in United States	$ 150.0	$ 161.0	$ 188.7	$ 201.9
Within firm	137.1	142.4	168.0	
Outside firm	12.3	18.6	20.7	
Amount spent in foreign countries	$ 29.1	$ 30.0	$ 39.4	$ 46.4
Within firm	21.0	27.8	36.0	
Outside firm	8.1	2.2	3.4	
TOTAL Veterinary R&D	$ 179.1	$ 191.0	$ 228.1	$ 248.3
TOTAL Company-Financed R&D for Pharmaceuticals	$4,736.0	$5,501.3	$6,456.5	$7,264.6
U.S. Government Grants and Contracts for Company-Conducted Pharmaceutical R&D	4.1	3.9	4.5	6.2
TOTAL Expenditures for Pharmaceutical R&D	**$4,740.1**	**$5,505.2**	**$6,461.0**	**$7,270.8**

1987–1989 Research and Development Expenditures Abroad

- R&D spending abroad by PMA members increased more than 15% in 1987. The share of total R&D spending performed abroad was 18% in 1986 and 1987. 19.0% was budgeted for 1988.

Tables 12 and 13

R&D Expenditures for Ethical Pharmaceuticals (millions of dollars) 1987 (actual), 1988 (budgeted), and 1989 (projected)

12

	1987		1988		1989	
	Amount	Change 1986–87	Amount	Change 1987–88	Amount	Change 1988–89
Company-Financed, for Human-Use Pharmaceuticals:						
Amount spent in U.S.	$4,342.2	+ 16.7%	$5,046.6	+ 16.2%	$5,645.2	+ 11.9%
Amount spent in foreign countries	968.1	+ 15.8%	1,181.8	+ 22.1%	1,371.1	16.0%
Company-Financed, for Veterinary-Use Pharmaceuticals:						
Amount spent in U.S.	161.0	+ 7.3%	$ 188.7	17.2%	$ 201.9	+ 7.0%
Amount spent in foreign countries	30.0	+ 3.1%	39.4	31.3%	46.4	+ 17.8%

Domestic and Foreign Shares of Company-Funded R&D Expenditures 1982–88 (percentages)

13

R&D Expenditures, Human- and Animal-Use Pharmaceuticals	1982	1983	1984	1985	1986	1987	1988*
Domestic	81.8	83.0	83.0	83.0	82.0	82.0	81.0
Foreign	18.2	17.0	17.0	17.0	18.0	18.0	19.0
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

*1988 figures are budgeted or estimated.

1986–1989 Research and Development Distribution of Expenditures

- The share of expenditures devoted to human-use drug research continued to increase slightly. Human-use drug research accounted for 96.4% of total expenditures in 1987 and 1988 (budgeted), and 96.5% in 1989 (projected).

- The share of expenditures for intramural research in the United States for human-use drugs, about two-thirds of the total, has shown a small decline each year since 1983. Budgeted figures for 1988 show a decline of about 2%.

Table 14

R&D Expenditures for Ethical Pharmaceuticals, Allocation of Funds (percentages) 1986, 1987 (actual), 1988 (budgeted), and 1989 (projected)

14

Category of R&D Expenditures for Ethical Pharmaceuticals	1986	1987	1988 (Budgeted)	1989 (Projected)
Company-Financed R&D Expenditures for Human-Use Products:				
Percentage spent in the United States	78.50%	78.87%	78.11%	77.64%
Within firm	65.42	63.73	62.19	
Outside firm	13.08	15.14	15.92	
Percentage spent in foreign countries	17.64%	17.59%	18.29%	18.86%
Within firm	14.78	14.23	14.65	
Outside firm	2.86	3.36	3.64	
TOTAL Human-use R&D	96.14%	96.46%	96.40%	96.50%
Company-Financed R&D Expenditures for Veterinary-Use Products:				
Percentage spent in the United States	3.16%	2.92%	2.92%	2.77%
Within firm	2.90	2.59	2.60	
Outside firm	.26	.33	.32	
Percentage spent in foreign countries	.61%	.55%	.61%	.64%
Within firm	.44	.51	.56	
Outside firm	.17	.04	.05	
TOTAL Veterinary R&D	3.77%	3.47%	3.53%	3.41%
TOTAL Company-Financed R&D	99.91	99.93	99.93	99.91
U.S. Government Grants and Contracts for Company-Conducted R&D	.09	.07	.07	.09
TOTAL Expenditures for R&D	100.00%	100.00%	100.00%	100.00%

Research by Geographic Area, 1986, 1987

- More than 69% of the research funds spent abroad were spent in Western Europe in 1987. In 1986 the figure was 71%.
- Japan, Australia and New Zealand accounted for 19% of foreign expenditures, Canada for 8% and Latin America for 2%.

Distribution of R&D Expenditures Abroad by Geographic Area, 1986, 1987

15

Area	Percentage of Total 1986	1987
Canada	7.5%	7.6%
Latin America (Central America, South America, Caribbean, excluding Cuba)	2.1	2.0
Western Europe (excluding Turkey, Yugoslavia and Albania; including Greece and Scandinavia)	71.1	69.8
Middle East	.4	.2
Africa	.6	.5
Far East and Pacific (from Pakistan to Pacific Islands)	.6	.4
Japan, Australia and New Zealand	17.6	19.4
Socialist Bloc (including Eastern Europe, U.S.S.R., Yugoslavia, Albania, People's Republic of China, Laos, Cambodia and Vietnam)	.1	.1
TOTAL	100.0%	100.0%

Research and Development Allocation of Expenditures to New Product Research

- 84% of R&D funds are spent for research and development of new products; 16% goes for improvement of existing products.
- Abroad, the ratio of new product/existing product expenditures is 78/22.

Tables 16 and 17

Company-Financed R&D Expenditures in the United States 1987 (percentages) 16

	Human-and Veterinary-Use R&D 1987
Research for the Advancement of Scientific Knowledge and Development of New Products and Related Services	84.0%
Research Oriented to Significant Improvements and/or Modification of Existing Products	16.0%
TOTAL	100.0%

Company-Financed R&D Expenditures in Foreign Countries, 1987 (percentages) 17

	Human-and Veterinary-Use R&D 1987
Research for the Advancement of Scientific Knowledge and Development of New Products and Related Services	78.0%
Research Oriented to Significant Improvement and/or Modification of Existing Products	22.0%
TOTAL	100.0%

1986, 1987 Research and Development Allocation of Expenditures by Product Class

- More than 73% of the research funds went to investigations related to infections, central nervous system, neoplasms, and the heart.
- Cardiovascular product research led with 27% of the total in 1987.
- Increases in the relative share of total expenditures went to research on central nervous system, cardiovasculars and neoplasms and endocrine.
- Research expenditures abroad are most often directed to cardiovascular products. Research on anti-infectives, neoplasms, and central nervous system also receive large shares of total expenditures.

Tables 18 and 19

U.S. R&D Expenditures for Pharmaceuticals, by Product Class, 1986, 1987 (percentages) **18**

Product Class	1986	1987
Anti-infectives	13.9%	13.1%
Central Nervous System and Sense Organs	14.2	14.5
Cardiovasculars	25.8	27.0
Neoplasms, Endocrine System and Metabolic Diseases	18.1	19.3
Gastrointestinal and Genitourinary System	5.7	5.3
Respiratory	6.2	5.3
Biologicals	2.3	2.8
Dermatologicals	2.0	2.1
Vitamins	.5	.2
Diagnostic (in vivo)	.5	.7
Other	7.4	6.0
Veterinary Preparations	3.1	3.4
Veterinary Biologicals	.3	.3
TOTAL	100.0%	100.0%

R&D Expenditures Abroad for Pharmaceuticals, by Product Class, 1986, 1987 (percentages)

19

Product Class	1986	1987
Anti-infectives	14.6%	15.2%
Cardiovasculars	25.6	28.9
Central Nervous System and Sense Organs	13.7	14.6
Gastrointestinal and Genitourinary System	8.2	8.5
Neoplasms, Endocrine System and Metabolic Diseases	11.0	9.0
Respiratory	7.5	7.0
Dermatologicals	2.0	1.3
Biologicals	3.5	3.1
Vitamins	1.4	.1
Diagnostic (in vivo)	1.2	.1
Other	7.9	7.7
Veterinary Preparations	3.4	4.5
Veterinary Biologicals	0.0	0.0
TOTAL	100.0%	100.0%

Research and Development Allocation of Expenditures by Function

- About half of all R&D expenditures is allocated to Biological Screening and Pharmacological Testing, Clinical Evaluation, and Synthesis and Extraction.
- The largest share, 24%, is spent on Clinical Evaluation: Phases I, II, and III.

Distribution of U.S. R&D Expenditures for Ethical Pharmaceuticals by Function

20

Function	Percentage of Total 1986	1987
Clinical Evaluation: Phases I, II, III	22.7%	24.0%
Biological Screening and Pharmacological Testing	15.5	16.8
Synthesis and Extraction	11.3	10.3
Pharmaceutical Dosage Formulation and Stability Testing	9.8	9.1
Toxicology and Safety Testing	8.6	8.3
Process Development for Manufacturing and Quality Control	9.5	9.4
Clinical Evaluation: Phase IV	3.7	4.4
Regulatory, IND and NDA Preparation, Submission and Processing	4.4	3.6
Bioavailability Studies	2.6	3.0
Other	11.9	11.1
TOTAL	100.0%	100.0%

1985-1987 Research and Development Employment

- R&D employment in PMA member firms totalled 50,610 in 1987, 81% of this total in the U.S. This total represents a 6% increase over 1985.
- The average R&D expenditure per R&D employee in the U.S. was $93,068 in 1987, 6% higher than the figure for 1986.
- Firms investing over $100 million in R&D employed about 54% of total R&D personnel in the U.S.

Tables 21, 22, 23 and 24

R&D Personnel in the United States, by Position Level

21

Category	1985	1986	1987
Scientific and Professional	21,850	24,500	26,890
Technical	6,160	6,250	6,260
Supporting Staff	7,790	7,520	7,760
Total	35,800	38,270	40,910

R&D Personnel in U.S. and Abroad, 1983–1987

22

Year	Grand Total	U.S.	Abroad
1983	40,200	31,800	8,400
	(100%)	(79%)	(21%)
1984	42,600	34,100	8,500
	(100%)	(80%)	(20%)
1985	44,700	35,800	8,900
	(100%)	(80%)	(20%)
1986	47,770	38,270	9,500
	(100%)	(80%)	(20%)
1987	50,610	40,910	9,700
	(100%)	(81%)	(19%)

U.S. Intramural R&D Expenditures for Human and Veterinary Use Pharmaceuticals per R&D Employee, 1987

23

Annual R&D Expenditure	Average Expenditure per R&D Employee 1987
Over $100 million	$100,832
$30-$100 million	82,814
Under $30 million	49,862
Average, All Firms	93,068

R&D Employment by Company R&D Expenditures, 1987

24

Annual R&D Expenditures	Total	Scientific & Professional	Technicians	Supporting	Scientists per 100 Employees
Over $100 million	27,270	18,160	4,000	5,110	66
$30–100 million	7,340	4,930	850	1,560	67
Under $30 million	6,300	3,800	1,410	1,090	60
Total:	40,910	26,890	6,260	7,760	66

Research and Development/Sales Ratio

- The percentage of the domestic pharmaceutical sales dollar allocated to domestic R&D was 15.8% in 1987. For 1988 the estimated percentage is 16.3% and the projected ratio for 1989 is 16.2%.

R&D as a Percentage of Sales, Ethical Pharmaceuticals 25

Year	1983	1984	1985	1986	1987	1988*	1989**	Average 1983–1989
Ratio	14.4	14.4	14.8	14.8	15.8	16.3	16.2	15.2

Human and veterinary ethical pharmaceuticals. R&D is domestic U.S. only as financed by companies for internal and external performance. Sales basis: Domestic sales plus exports to other firms and intrafirm exports but excluding sales of foreign plants owned by U.S. firms. Data represent all PMA member firms.

*Estimated or Budgeted

**Projected

Glossary

Definitions used in the 1987-1989 Survey

Biologicals—bacterial and virus vaccine, antigens, antitoxins, toxoids, and analogous products (such as allergenic extracts), serums, plasmas, and other blood derivatives for human use.

Bulk—For use as a pharmaceutical or medicinal product in further manufacture or in packaging by another company, or for processing in animal feeds (but not as nutritional ingredients), or in prescription compounding, etc.

Company or Firm—Manufacturers including parent, affiliated and subsidiary companies, without duplication engaged in production of ethical pharmaceuticals, biologicals, and diagnostic products.

Diagnostic Agents (in vivo)—Diagnostic products used in living body.

Employment—All full-time production workers as well as officers of the company, including employees engaged in the following activities: factory supervision above the working foreman level, sales, advertising, financial, clerical, executive, purchasing, legal, personnel, professional and technical.

1. *Production Workers*—Employees up through the working foreman level engaged in fabricating, processing, assembling, receiving, inspection, quality control, handling, packing, warehousing and storage, shipping, maintenance, repair, janitorial, watchman service, production development, record keeping, and other services associated with the production operations.
2. *Medical Research and Development*—Personnel engaged in research, research administration, clinical evaluation and development; excludes personnel in promotion, sales, market research, business administration, production and quality control.
3. *Sales and Marketing Research Employees*—Personnel in sales, advertising, sales promotion, market research, etc.
4. *Administrative Employees*—Personnel responsible for general management, accounting, finance, planning, personnel, purchasing office services, legal, secretarial, etc.
5. *Distribution*—Personnel responsible for distribution, including transportation and warehousing.

Employment Abroad—Total number of full-time employees, whether U.S. citizens or not, of PMA member firms or any wholly owned overseas corporation, or corporations in which PMA member firms had a substantial or controlling interest.

Ethical Pharmaceuticals—Products, including biological and medicinal chemicals, used for the cure, alleviation, mitigation, treatment, prevention or diagnosis of disease in humans or animals and promoted primarily to the medical, pharmacy and allied professions; includes products for over-the-counter ethical sales as well as for ultimate dispensing by prescription only.

Exports—"f.o.b." U.S. port.

a) To other firms: sales to third parties only.

b) Intrafirm transactions: sales and shipments at billed (and end sales) value to subsidiaries and affiliates for further handling, processing or packaging.

Governmental Grants and Contracts for Company-Conducted R&D—Grants and contractual payments received by companies from governmental agencies for pharmaceutical research and development.

Over-The-Counter Ethical—A drug product sold over the counter but primarily promoted to the professions. This does not include proprietary drugs (i.e., OTC products on display for purchase by consumers).

Prescription Legend—A drug product which by Federal law is available only by prescription from a licensed physician.

Research and Development—The term includes basic and applied research as well as development activities carried on or supported in the pharmaceutical, biological, chemical, medical and related sciences, including psychology and psychiatry, if the purpose of such activities is concerned ultimately with the utilization of scientific principles in understanding diseases or in improving health.

R&D Expenditures—The total cost incurred for all pharmaceutical research and development activity, including cost of salaries, other direct costs, service, routine supplies, and supporting costs, plus a fair share of overhead (administration, depreciation, space charges, rent, etc.).

Costs of drugs or medical research and development conducted on grant or contract for other companies are excluded. Conversely, total outlays for all research and development work contracted to others (manufacturers, independent research laboratories, academic institutions, etc.) are included.

Research and Development Expenditures Within Firm—Includes research and development expenditures in the United States and foreign countries in the firm's own research laboratories.

Research and Development Expenditures Outside Firm—Research and development funds contracted or granted to such organizations as commercial laboratories, private practitioners, consultants, etc., educational institutions, non-profit research institutions, manufacturing and other companies or other research performing organizations.

R&D Manpower—Personnel engaged in research, research administration, clinical evaluation and development: excludes personnel in promotion, sales, market research, business administration, production and quality control.

Research and Development Scientific and Professional Staff—Includes all persons whose work requires the application for research and development of knowledge, skills and scientific techniques, in the life, physical, engineering, or mathematical sciences, acquired through the completion of a four-year college course (or its equivalent) with a major in these fields or in medicine or other health professions. Excludes persons who have formal training in the sciences but who are not actively engaged in research and development.

Research and Development Support Staff—Includes persons who provide literature, clinical, statistical, or other services specifically for R&D staff and technicians.

Research and Development Technicians—Includes persons actually engaged in technical work at a level which requires knowledge of the life, physical engineering, or mathematical sciences comparable at least to that acquired through technical institutes, junior colleges, or other formal post-high school training less extensive than four-year college training, or through equivalent on-the-job training or experience. However, also included are persons who hold an academic degree at the bachelor's level or above.

Sales—Sales figures are reported as billed (before deducting cash discounts on sales and other marketing expense), less returns and allowances. Includes sales value of products bought and resold without further processing or repacking as well as the dollar value of products made from own materials for other manufacturers' resale. Excluded are all royalty payments, interest and other income.

Sales Abroad—Actual sales consummated in foreign countries other than "Sales for Exports or Other Firms." Such sales by affiliates and subsidiaries or other operations abroad are reported in dollars, computed at December 31 rate of exchange (when possible) for the year shown. Where a partially owned subsidiary is involved, the firm's share is determined on a proportionate profit-sharing basis.

Sales for Export—Reported as "f.o.b. U.S. port."

1. *To Other Firms*—Excludes intracompany transactions, includes sales to third parties only.
2. *Intracompany Transactions*—Includes sales and shipments to subsidiaries or affiliates for further handling, processing, or finishing by them. Reported as net billed value, not end sales values.

Sales by Product Class—Estimated distribution of domestic sales of ethical pharmaceutical and biological dosage-form preparations in accordance with the classification system used in the annual Current Industrial Reports from the Bureau of the Census.

Sales to Governments—Sales or shipments made directly to federal, state or local government agencies, hospitals and clinics.

Sales to Private Sector—Sales through regular marketing channels for end-use other than by government agency administration or distribution.

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